Quarterly Report FY09Q2

Project Name: PHENIX-VTX Date: May 5, 2009
Contract Project Manager: Yasuyuki Akiba

Narrative of project highlights:

Pixel:

- 150 sensor module Q/A have been completed. The last batch of 15 modules has a very good (~80%) yield.
- Extender (w/o SMD parts) production completed
- Bus production is in progress
- SPIRO production board was tested. No problems found.
- FEE production has started
- Pixel stave production is well on-going, and will be completed soon.
- Encapsulation method of wire bonding between sensor module and the bus is established
- The assembly of the first production ladder was not successful. We are re-examining the assembly procedure.

Strip:

- ROC-3 prime modules are tested. The tests show good signal/noise performance.
- ppROCs are produced
- The first silicon modules based on ppROC (without sensor) is produced at BNL
- Assembly fixtures for silicon modules are produced
- Aluminum stave, used for testing silicon modules, are produced
- Six more ppROC based silicon modules are assembled at FNAL SiDET.
- Paperwork for module assembly at FNAL is in progress
- RCC, the strip bus, LDTB board are produced at ORNL
- The first ppROC silicon module is read-out through RCC+bus+LDTB at ORNL
- Minor revisions of the layout of ppROC for production is in progress.
  (The revision was completed in April 2009.)

Mechanics:

- Design of the new Be Beam pipe (40mm ID) is updated by the manufacturer. Customer Approval Print is signed off by all party.
- Pixel stave production at LBNL is in progress
- Task Order #1 is extended and the work is resumed.
  - Pixel barrel mount complete
  - Strip stave thermal study in progress

Software

- Simulation of b→e / c→e separation
- Preparing for Blind Challenge

Summary of milestones covered during review period:

- The following 12 control milestones are covered or delayed in this quarter.

- The project complete date remains 09/2010 consistent with the baseline project complete date.
- There are 15 weeks of schedule contingency included on the critical path of the project. The project is scheduled to complete in 77 weeks.

1) WBS 1.1.1.4
   A pre-production ROC/RCC performs to the specifications.

Baseline completion date: FY08 2nd Quarter
Completion date: FY09Q3 (unchanged)
This milestone is on the critical path.
This is a chain test of pre-production ROC (ppROC) +RCC. In the present read-out scheme of the strip detector, a strip ladder consists of 5 or 6 strip silicon modules and each of them is read-out by one RCC board. All of RCC boards on a ladder are connected by a strip bus, which is read-out by a Ladder Data Transfer Board (LDTB). All components need to assembly prototype ladders were produced in FY09Q2. A prototype ladder consisting of 1 ppROC (without sensor) and 1 RCC board connected to a bus was successfully read-out by a prototype LDTB board at the end of March 2009. Prototype ladders made of 1 ppROC sensor module (with sensor) and 1 RCC will be tested in early April, 2009.
(This milestone was completed in middle of April 2009.)

2) WBS 1.5.2.14
   Prototype strip stave delivered

Baseline completion date: FY08 2nd Quarter
Completion date: FY09 3rd Quarter (unchanged)
This milestone is on the critical path

Now the stave design is being finalized. The thermal study simulation is in progress. This milestone is now expected to be completed in early FY09 Q3.
(The thermal study was completed in April 2009.)

3) WBS1.1.3.4
   A pre-production strip ladder performs to the specification. This is a system chain test of the strip ladder.

Baseline completion date: FY08 4th Quarter
Completion date: FY09 4th Quarter (unchanged)
This milestone is on the critical path

After the chain test of ROC+RCC (WBS 1.1.1.4) a pre-production strip ladder will be assembled and tested. This is the final test of the strip ladder. This milestone is now expected to be completed in FY09 Q4.

4) WBS1.1.1.7 (delayed)
   246 + spare of the strip ROCs perform to the specification. They are sufficient for building the entire strip subsystem.

Baseline completion date: FY09 2nd Quarter

New completion date: FY09 4th Quarter

After the test of ppROC/RCC, production ROC will be designed and fabricated. The layout of production ROC (with minor revision from ppROC) was near completion as of end of March, 2009, and it was completed in April 2009. The fabrication of production ROC is a critical path. This milestone is now expected to be completed in early FY10 Q1.

5) WBS1.1.2.5
   246 + spare strip sensors are Q/A'd. They are sufficient for building the entire strip detector subsystem.

Baseline completion date: FY08 1st Quarter
New completion date: FY09 3rd Quarter (unchanged)

The sensors were Q/A'd by the manufacturer (Hamamatsu Co.), and only good sensors that passed the Q/A were delivered with the Q/A data. We will test a subset of the delivered sensor at BNL. Four hundred of the production sensors are now at BNL, and we performed basic IV/CV tests of all of these sensors. We found a good agreement between our measurements and HPK's measurements. In addition, we plan to do a full test (IV/CV tests of all strips) of 1/3 of sensors. This milestone is now expected to be complete in FY09 Q3. This milestone is not a critical path since we already have sufficient number of tested sensors to start production of sensor modules.

6) WBS1.5.2.15 (delayed)
   30 + spare pixel staves are delivered. They are sufficient for building the entire pixel

Baseline completion date: FY08 4th Quarter
New completion date: FY09 3rd Quarter (FY09Q2→FY09Q3)

First articles of pixel staves were produced at LBNL in December, and they met the mechanical specifications. Full production of pixel ladder is in progress and more than 50% completed. This milestone was expected to be completed in March 2009 in the previous quarterly report. This milestone is now expected to complete in middle of May.

7) WBS1.2.4.6 (delayed)
   60 pixel bus extenders + spares are fabricated. This is the responsibility of RIKEN.

Baseline completion date: FY08 3rd Quarter
New completion date: FY09 3rd Quarter (FY09Q2→FY09Q3)

75 extenders without passive components were delivered at the end of March. Parts assembly is in progress. This milestone is expected to be completed in early FY09 Q3.

8) WBS 1.2.4.5 (delayed)
   60 pixel buses + spares fabricated. This is the responsibility of RIKEN

Baseline completion date: FY08 1st Quarter
New completion date: FY09 3rd Quarter (FY09Q2→FY09Q3)

The production of the bus is in progress. The first articles of the production buses have been delivered in November. Both of the left and the right version of buses, 5 pieces of each, were produced. This mile stone is now expected to complete in FY09 Q3.

9) WBS 1.2.5.5 (delayed)
   60 pixel SPIRO modules + spare perform to spec. This is the responsibility of Ecole Polytech and RIKEN

Baseline completion date: FY08 2^{nd} Quarter
New completion date: FY09 4^{th} Quarter (FY09Q3→FY09Q4)

Production of SPIRO boards is in progress. The delay is caused by the final test of the first article of SPIRO board using a production ladder. This is finally cleared in early April 2009 and full production has started. This milestone is now expected to be completed in FY09 Q4.

10) WBS1.2.6.4 (delayed)
   30 pixel FEMs + spares perform to the specification. This is the responsibility of RIKEN/French group.

Baseline completion date: FY09 1^{st} Quarter
New completion date: FY09 4^{th} Quarter (FY09Q3→FY09Q4)

Production of pixel FEM is in progress at Stony Brook. PCBs have been fabricated and FPGAs and other parts were purchased at the end of FY09Q2. The boards will be assembled soon. This mile stone is now expected to complete early FY09 Q4.

11) WBS1.2.3.4 (delayed)
   120 + spare pixel sensor modules are tested and they performs to the specification. They are sufficient for building the entire pixel subsystem, including spares. This is the responsibility of RIKEN.

Baseline completion date: FY07 4^{th} Quarter
New completion date: FY10 1st Quarter (FY09Q4→FY10Q1)

We received 15 new sensor modules from VTT in December, and Q/A tests of them is in progress at RIKEN. We have received total of 150 sensor modules and all of them has been tested. The yield of the Class-I modules have been ~60% and some of them are used for prototype and testing. Presently, we have 69 Class-I (good) modules and 10 Class-II (usable) modules at RIKEN at the end of FY09Q2.

One sensor module has 4 chips and most of the Class-III modules have only one bad chip. VTT can replace those bad chips with new chips, with success rate of ~80%. We sent 35 Class-III modules to VTT for rework in January 2009. We will also purchase more sensors to produce sufficient number of sensor modules.

This milestone is now expected to complete in FY10 Q1. The new completion date is not on the critical path for the pixel part of the project since we have sufficient pixel sensor modules to begin pixel ladder assembly.

12) WBS1.2.9.5

30 pixel ladders and spares are assembled. This is the responsibility of RIKEN.

Baseline completion date: FY09 2nd Quarter
New completion date: FY10 1st Quarter

A pixel ladder consists of 4 sensor modules, 2 pixel buses and 1 mechanical stave. Production of pixel staves is in progress LBNL. However, the start of the ladder assembly is delayed due to a technical issue, i.e. to glue sensor modules on a stave. Once this problem is solved, production of pixel ladder will start. This milestone is now expected to complete at the end of FY10 Q1.

Critical Path of the Project

Critical path of the project is formed by the following processes:

- Design and production of strip ROCs (Figure 1)
- Design and production of strip staves (Figure 2)
- Assembly of the strip silicon modules and ladders (Figure 3)
- Installation of the ladders in the VTX

The three critical path processes are going parallel, so they are shown in separately in Figure 1 to Figure 3. Figure 4 shows the combined critical path of the project.

The items without WBS number in Figure 1 to Figure 4 are schedule contingency. There are total of 15 weeks of schedule contingency included on the Project Critical Path. Schedule contingency is 15 wks/77 wks ~ 20%.

ID	WBS	Task Name	Start	Finish	Duration
265	1.1.3.3.5	assemble modules + non_ROC components into partial chain ladder	Sun 3/15/09	Fri 3/27/09	2 wks
266	1.1.3.3.6	strip system test BNL: test of pre-production partial chain ladder	Sun 3/15/09	Mon 4/13/09	20 days
267		contingency	Tue 4/14/09	Mon 5/4/09	3 wks
198	1.1.1.4	Milestone: pre-production ROC perform to spec	Mon 5/4/09	Mon 5/4/09	0 days
277	1.1.3.8	Milestone: Pre-production strip partial chain ladder (modules+bus) pe	Mon 5/4/09	Mon 5/4/09	0 days
93	1.1.1.9.1.2	layout design Production ROC	Thu 1/15/09	Mon 5/18/09	20 days
95	1.1.1.9.2.1	prepare documents production ROC Design Review	Tue 4/28/09	Mon 5/18/09	15 days
97	1.1.1.9.3.1	Fab board Production ROC	Tue 5/19/09	Tue 6/16/09	20 days
99	1.1.1.9.3.3	assembly of passive components on the ROC	Wed 6/17/09	Thu 7/30/09	30 days
100	1.1.1.9.3.4	assembly of SVX4 on the ROC (FNAL)	Fri 7/31/09	Thu 8/27/09	20 days
103	1.1.1.9.4.2	Test Production ROC	Fri 8/14/09	Fri 10/9/09	40 days

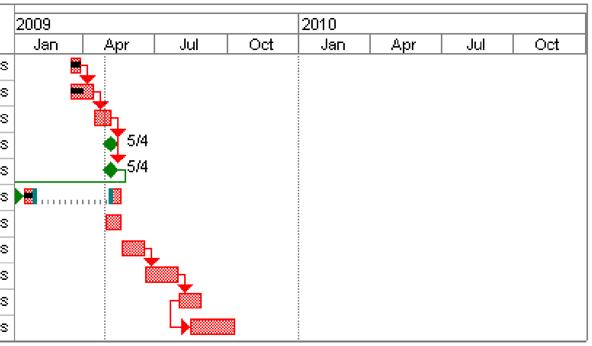

Figure 1 Critical path of ROC production

ID	WBS	Task Name	Start	Finish	Duration
559	1.5.2.2.1.1	design+protoype strip staves	Fri 6/1/07	Mon 6/29/09	100 days
305	1.1.4.2.3	design of strip ladder assembly fixtures	Mon 5/4/09	Fri 5/22/09	3 wks
306	1.1.4.2.4	fabricate strip ladder assembly fixtures	Tue 5/26/09	Mon 6/15/09	3 wks
307		contingency	Tue 6/16/09	Wed 7/8/09	3 wks
268	1.1.3.3.18	trial runs of assembly procedure pre-production ladder	Thu 7/9/09	Wed 7/29/09	3 wks
269		contingency	Thu 7/30/09	Wed 8/5/09	1 wk
279	1.1.3.10	Milestone: Pre-Production strip ladder performs to mechanical spec	Wed 8/5/09	Wed 8/5/09	0 days
563	1.5.2.2.2.2	Tooling strip staves	Thu 8/6/09	Wed 8/26/09	3 wks
564	1.5.2.2.2.3	fabrication strip staves	Thu 8/27/09	Thu 10/1/09	5 wks
566		contingency	Fri 10/2/09	Thu 10/22/09	3 wks

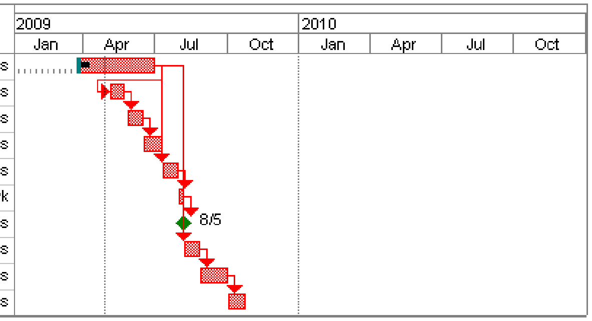

Figure 2 Critical path Strip Stave production

ID	WBS	Task Name	Start	Finish	Duration
313	1.1.4.4.1	Glue ROC on sensor (FNAL)	Fri 8/28/09	Fri 4/23/10	8 mons
314	1.1.4.4.2	wire bond ROC+Sensor=>sensor module	Fri 9/4/09	Fri 4/30/10	8 mons
315	1.1.4.4.3	test assembled sensor modules	Mon 9/14/09	Fri 4/30/10	7.75 mons
316	1.1.4.4.4	Mount sensor modules on stave with non-ROC ladder components	Mon 9/28/09	Fri 4/9/10	6.5 mons
317	1.1.4.4.5	test assembled strip ladders	Mon 9/28/09	Fri 4/16/10	6.75 mons
318		contingency	Mon 4/19/10	Fri 6/18/10	9 wks
320	1.1.4.6	Milestone: 44 strip ladders + spare performs to spec	Fri 6/18/10	Fri 6/18/10	0 days
680	1.5.3.2.1	align + fix strip ladders onto barrel mounts	Mon 6/21/10	Tue 7/13/10	0.83 mons
681	1.5.3.2.2	test strip ladders on barrel	Tue 7/13/10	Tue 7/27/10	2 wks
682		contingency	Tue 7/27/10	Tue 8/17/10	3 wks
683	1.5.3.3	Complete assembly of barrel+space-frame	Tue 8/17/10	Tue 8/24/10	1 wk
684		contingency	Tue 8/24/10	Tue 8/31/10	1 wk
685	1.5.3.4	Milestone - all ladders on VTX	Tue 8/31/10	Tue 8/31/10	0 days
533	1.4.4.1	Testing of fully assembled barrel detector	Tue 8/31/10	Tue 9/21/10	3 wks
534		contingency	Tue 9/21/10	Tue 9/28/10	1 wk
719	1.6.5	Milestone: project complete	Tue 9/28/10	Tue 9/28/10	0 days

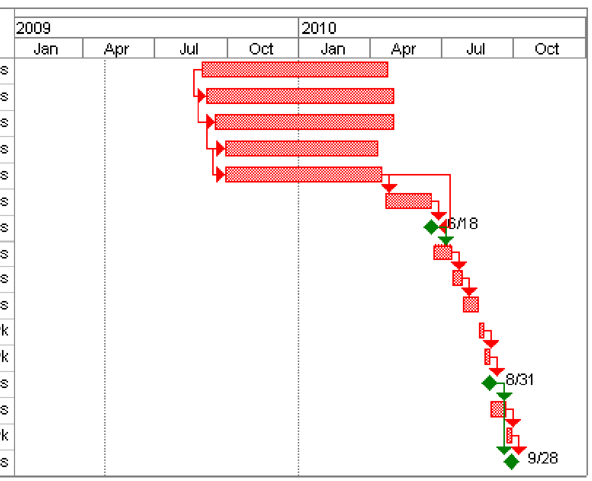

Figure 3 Critical path of Assembly of strip ladder

ID	WBS	Task Name	Start	Finish	Duration
93	1.1.1.9.1.2	layout design Production ROC	Thu 1/15/09	Mon 5/18/09	20 days
95	1.1.1.9.2.1	prepare documents production ROC Design Review	Tue 4/28/09	Mon 5/18/09	15 days
97	1.1.1.9.3.1	Fab board Production ROC	Tue 5/19/09	Tue 6/16/09	20 days
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103	1.1.1.9.4.2	Test Production ROC	Fri 8/14/09	Fri 10/9/09	40 days
198	1.1.1.4	Milestone: pre-production ROC perform to spec	Mon 5/4/09	Mon 5/4/09	0 days
265	1.1.3.3.5	assemble modules + non_ROC components into partial chain ladder	Sun 3/15/09	Fri 3/27/09	2 wks
266	1.1.3.3.6	strip system test BNL: test of pre-production partial chain ladder	Sun 3/15/09	Mon 4/13/09	20 days
267		contingency	Tue 4/14/09	Mon 5/4/09	3 wks
268	1.1.3.3.18	trial runs of assembly procedure pre-production ladder	Thu 7/9/09	Wed 7/29/09	3 wks
269		contingency	Thu 7/30/09	Wed 8/5/09	1 wk
277	1.1.3.8	Milestone: Pre-production strip partial chain ladder (modules+bus) pe	Mon 5/4/09	Mon 5/4/09	0 days
279	1.1.3.10	Milestone: Pre-Production strip ladder performs to mechanical spec	Wed 8/5/09	Wed 8/5/09	0 days
305	1.1.4.2.3	design of strip ladder assembly fixtures	Mon 5/4/09	Fri 5/22/09	3 wks
306	1.1.4.2.4	fabricate strip ladder assembly fixtures	Tue 5/26/09	Mon 6/15/09	3 wks
307		contingency	Tue 6/16/09	Wed 7/8/09	3 wks
313	1.1.4.4.1	Glue ROC on sensor (FNAL)	Fri 8/28/09	Fri 4/23/10	8 mons
314	1.1.4.4.2	wire bond ROC+Sensor=>sensor module	Fri 9/4/09	Fri 4/30/10	8 mons
315	1.1.4.4.3	test assembled sensor modules	Mon 9/14/09	Fri 4/30/10	7.75 mons
316	1.1.4.4.4	Mount sensor modules on stave with non-ROC ladder components	Mon 9/28/09	Fri 4/9/10	6.5 mons
317	1.1.4.4.5	test assembled strip ladders	Mon 9/28/09	Fri 4/16/10	6.75 mons
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533	1.4.4.1	Testing of fully assembled barrel detector	Tue 8/31/10	Tue 9/21/10	3 wks
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559	1.5.2.2.1.1	design+protoype strip staves	Fri 6/1/07	Mon 6/29/09	100 days
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566		contingency	Fri 10/2/09	Thu 10/22/09	3 wks
680	1.5.3.2.1	align + fix strip ladders onto barrel mounts	Mon 6/21/10	Tue 7/13/10	0.83 mons
681	1.5.3.2.2	test strip ladders on barrel	Tue 7/13/10	Tue 7/27/10	2 wks
682		contingency	Tue 7/27/10	Tue 8/17/10	3 wks
683	1.5.3.3	Complete assembly of barrel+space-frame	Tue 8/17/10	Tue 8/24/10	1 wk
684		contingency	Tue 8/24/10	Tue 8/31/10	1 wk
685	1.5.3.4	Milestone - all ladders on VTX	Tue 8/31/10	Tue 8/31/10	0 days
719	1.6.5	Milestone: project complete	Tue 9/28/10	Tue 9/28/10	0 days

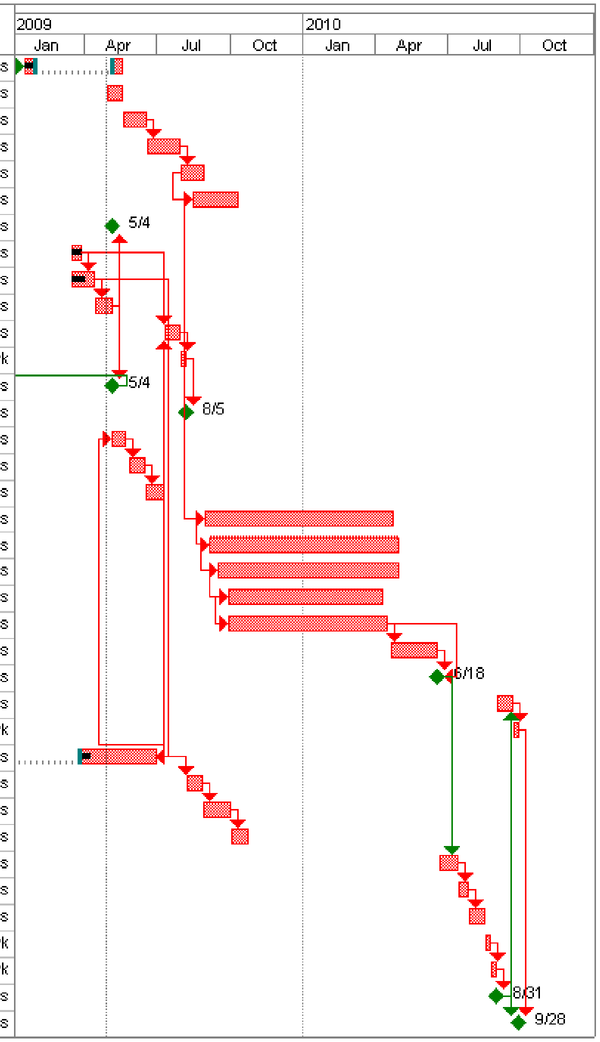

Figure 4 Combined Critical Path

- Summary of schedule: (based on sub sys. Manager report)

Table 1 Summary of percentage complete of the tasks

WBS	Baseline Start Date mo/year	Actual/ Forecast Start Date mo/year	Baseline Complete Date mo/year	Actual/ Forecast Completion Date mo/year	% Complete Baseline	% Complete Actual
1.1 Strip	10/2006	07/2007	05/2010	06/2010	77%	65%
1.2 Pixel	04/2005	07/2007	03/2009	01/2010	100%	81%
1.3 DAQ	10/2006	07/2008	04/2009	10/2009	97%	0%
1.4 Electronic Integration	10/2006	07/2007	09/2010	09/2010	86%	52%
1.5 Auxiliary system & integration	10/2006	07/2007	07/2010	08/2010	81%	56%
1.6 Management	10/2006	07/2007	09/2010	09/2010	68%	55%
1.7 Installation	07/2010	07/2010	09/2010	09/2010	0%	0%

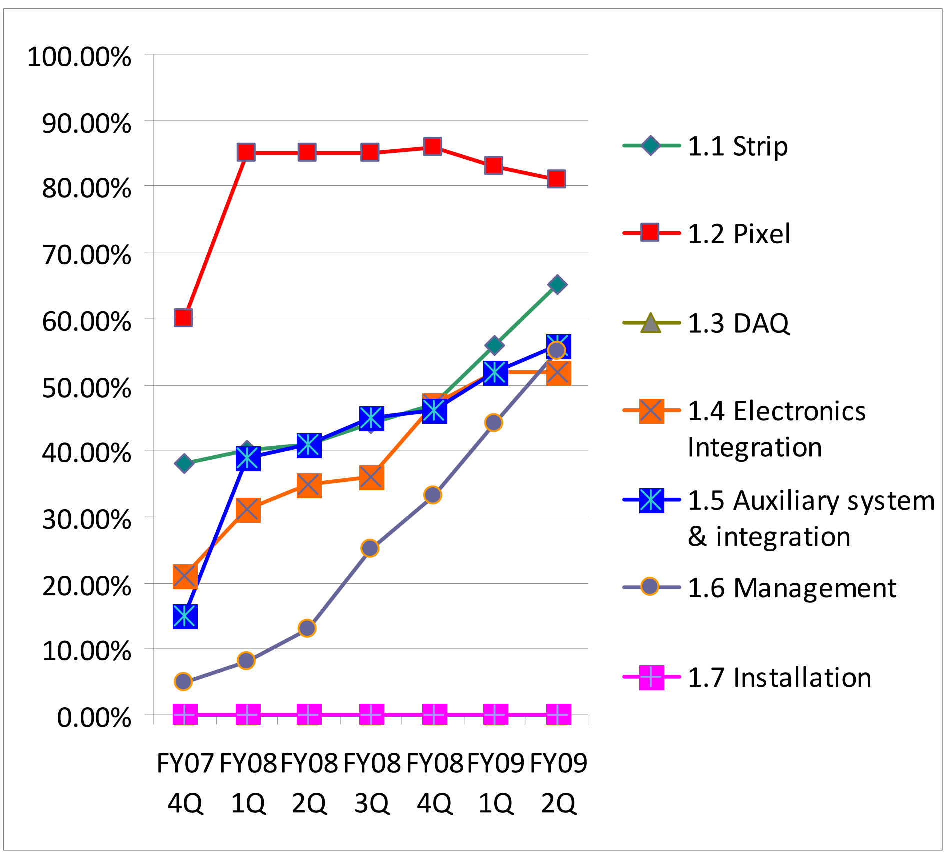

Figure 5 Historical tracking of percentage completed tasks.

Table 1 summarizes percentage complete of the major tasks of the project and compare them the baseline project. Figure 5 shows the historical tracking of percentage complete of the tasks (the last column of Table 1). Table 2 compares the completion date of the major milestones in the baseline schedule at the start of the project and the current schedule.

For the pixels system, the slow Q/A of the sensor modules and a technical problem in the ladder assembly causes a delay. The latter problem has been worked on. Meantime, final production of read-out electronics (SPIRO, FEE) and pixel stave are on going. All of the bus extender cables are delivered. Bus produciton is on going. Since pixel system have been well ahead of the over-all proejct, it is still far from the over-all critical path.

The strip system remains the critical path of the project, but it has made a major progress in this quarter. Pre-produciton ROCs are fabricated and silicon modules based on ppROC are assembled. Non-ROC ladder components (RCC boards, strip bus cable, LDTB) are designed and fabricated. The first electronic ladder was assembled and tests of the entire strip ladder read-out chain had started. the major cause of the delay had been the noise issue of the stripixel ROC. After the design change of the ROC and the read-out scheme the project is proceeding on schedule.

Table 2 Comparison of the completion date of the major milestones in the baseline and the current schedule

milestone	Name	baseline	Current	Complete	Delay (days)	Start slack (days)
Pixel						
1.2.3.4	120 + spare pixel sensor modules performs to spec	9/17/2007	6/18/2009	0%	640	82
1.2.4.5	60 pixel buses + spares fabricated	11/1/2007	5/1/2009	0%	547	90
1.2.9.3	1st prototype pixel ladder performs to electrical spec	8/2/2007	9/30/2007	100%	58	0
1.5.2.15	30 + spare pixel staves delivered	8/28/2008	5/15/2009	0%	260	134
1.2.9.5	30 pixel ladders assembled + spare	1/29/2009	12/11/2009	0%	316	82
Strip						
1.1.3.5	pre-production detector module perform to spec		4/23/2009			0
1.1.3.4	Pre-production strip ladder performs to spec	8/22/2008	8/5/2009	0%	348	16
1.1.1.6	123 ROCs performs to spec, sufficient ROCs for half-VTX	1/7/2009	9/11/2009	0%	247	90
1.5.2.16	44 + spare strip staves delivered	7/20/2009	10/22/2009	0%	94	11
1.1.4.5	22 strip ladders performs to spec, sufficient for half-VTX	11/9/2009	2/26/2010	0%	109	0
1.1.4.6	44 strip ladders + spare performs to spec	5/14/2010	6/18/2010	0%	35	0
Mech						
1.5.2.17	12 barrel mounts delivered	4/24/2009	12/15/2009	0%	235	167
1.5.2.18	space frame delivered	7/20/2009	3/5/2010	0%	228	112
1.5.4.3	infrastructure ready for installation	8/19/2009	9/1/2009	0%	13	268
1.5.3.4	all ladders on VTX	7/8/2010	8/31/2010	0%	54	0
Project						
1.6.5	Milestone: project complete	9/9/2010	9/27/2010	0%	18	0

- Summary of over-all schedule of the pixel and strip layers.

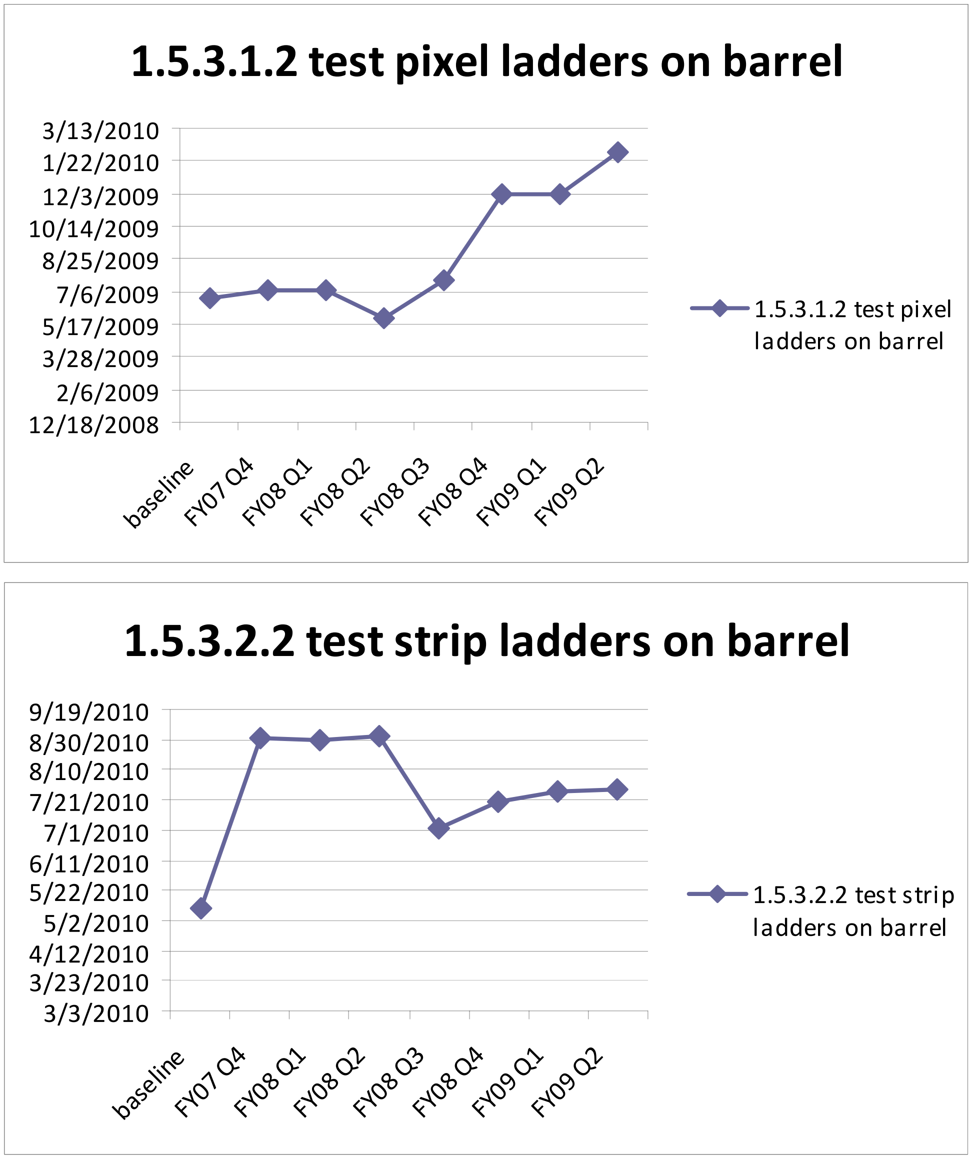

Figure 6 Historical Changes of the dates of two major milestones (tests in the barrel) in the Pixel and Strip systems in the project file

The two plots in Figure 6 show the historical changes of the dates of two major milestones in the project file. The top panel shows the projected date when all of the pixel ladders are tested on the barrel, i.e. the pixel system is ready to be installed. The second plot shows the date when all strip ladders are tested on the barrel. The plot shows that overall schedule of the project is not slipped since the first quarter report (FY07Q4).

Summary of expenditures:

Table 3 is the baseline project budget before the start. The baseline cost is $4.7M in actual year dollars including contingency.

Table 3 Baseline project budget

WBS	Item	Baseline Total Cost (AY$)	Costed & Committed	Estimate To Complete (AY$)	Estimated Total Cost (AY$)	Available Contingency (AY$)	Available Contingency (% of Est to Comp)
1.1	Strip	1,676	0	1345	1345	331	25
1.3	DAQ	200	0	160	160	40	25
1.4	Electronics System Integration	705	0	582	582	124	21
1.5	Auxiliary Systems & Integration	1940	0	1524	1524	416	27
1.6	Management	111	0	100	100	11	11
1.7	Installation	68	0	68	68		
Totals:		4700	0	3778	3778	922	24

Table 4 shows the status of the project at the end of FY09Q1

Table 4 Current project budget

WBS	Item	Baseline	Cost Accrued to date	Committed contract	To Complete	Estimated cost	Contingency	
		(AY k$)	(AY k$)	(AY k$)	(AY k$)	(AY k$)	(AY k$)	(% of Est to Comp)
1	VTX	4700	1567	466	2256	4289	411	18.2
1.1	Strip	1676	688	0	764	1452		
1.3	DAQ	200	0	0	199	199		
1.4	Electronic System Integration	705	144	119	211	475		
1.5	Auxiliary Systems & Integration	1940	699	344	986	2029		
1.6	Management	111	36	2	65	104		
1.7	Installation	68	0	0	30	30		

Table 5 shows cumulative amounts from the inception of the project. The commitment less accrued column shows that the remaining funds of the amount that was transferred to ORNL, LANL and LBNL plus the open commitment (i.e. the current ceiling of the amount of the contract less that has been spent to date) in the contracts with HYTEC, ISU and Nevis, including the estimated amount of BNL overhead.

Table 5 Cumulative amount of expenditure to the end of FY09Q2

	FY 2007	FY 2008	FY 2009
A) Funds allocated:	1,599	3,599	4,450
B) Costs accrued:	347	1,124	1,567
C) Open commitments	496	869	466
D) Remaining contingency:	922	561	411
E) Uncommitted funds (e=a-b-c)	756	1,606	2,417

Figures are Year to date

The remaining fund, 250K, will be allocated in April 2009.

Brief summary of project issues, concerns, successes

Pixel subsystem

Successes:

- 150 sensor module Q/A have been completed.
  Q/A test of the 15 new sensor modules from CERN/VTT has been completed. They have a good yield (12/15=86%). The summary of the Q/A tests and inventory of the sensor modules at RIKEN at the end of module Q/A is shown in Figure 7.
  From these modules, 6 Class-I (good) and 1 Class-II (usable) modules were used to produce test pixel ladders, and 3 Class-I were found to be degraded to Class-II. Presently we have 69 Class-I modules and 10 Class-II modules.
- Extender (w/o SMD parts) production completed (Figure 8).
- Bus production is in progress. Figure 9 shows the first articles of production bus delivered at RIKEN.
- SPIRO production board was tested at RIKEN using a pre-production ladder. No problem was found.
- FEE production has started
  PCB and components (FPGA, etc) for FEE were ordered and delivered at the end of FY09 Q2. The assembly will start soon.
- Pixel stave production is well on-going, and will be completed soon.
- Encapsulation method of wire bonding between sensor module and the bus is established

A total of **150 Ladders** have been tested,
in which **15 ladders** has already used for other purpose.

Class I	78 ladders
Class II	8 ladders
Class III	48 ladders

Figure 7 Summary of the sensor modules at RIKEN when Q/A tests of all 150 sensor modules delivered has been completed. Some of these Class I sensors are later used to make ladders.

Figure 8 A production bus extenders delivered to RIKEN.

Figure 9 First articles of pixel buses delivered to RIKEN

Issues and concerns

- More sensor modules are needed. Rework of Class-III sensor module have not started yet. This is pushing the schedule of completion date.
- Assembly of the first production ladder was not successful. The glue spilled out on the surface and damaged the detector. We need to establish a new, safer gluing method. This causes a delay in the pixel part of the project.
- Although the pixel detector has a large margin to be a critical path of the project, the schedule is slipping due to several unforeseen issues. We need to maintain the schedule of the subsystem.

Strip subsystem:

Successes:

- ROC-3 prime modules are tested with beta-ray source. The tests show good signal/noise performance (Figure 10) .The pedestal width (~9.6 ADC counts) is consistent with that of ROC3 modules and S/B ratio of MIP is ~10.
- Aluminum stave, used for testing and storage of silicon modules, are produced. One Aluminum stave can hold up to six silicon modules. The stave provides support and cooling.
- Assembly fixtures for silicon modules are produced. These fixtures are used to place SVX4 chips on a ROC and to place silicon sensor on a ROC. They were used to assembly ppROC based sensor modules at FNAL.
- The first silicon modules based on the ppROC (without sensor) was produce at BNL. After it was assembled, it was sent to ORNL for electrical tests and for debugging of read-out chain.
- Six more ppROC based silicon modules are assembled at FNAL SiDET. The assembly fixtures were used for the assembly work.
- Non-ROC ladder components (RCC, the strip bus, LDTB board) were produced at ORNL. They were used in a chain test to read-out the first ppROC module. Figure 11 shows a photograph of the read-out chain test setup. The first ppROC module is placed under the RCC at the far right and it is read-out by the RCC. The data is then read out through the strip bus cable to LDTB board at the left end of the bus.
  This test is part of milestone WBS1.1.1.4. The entire chain was read-out and the milestone was achieved in April 2009.
- A report on the radiation dose on RCC is written. The report recommends that we can use FPGA based RCC in RHIC environment.

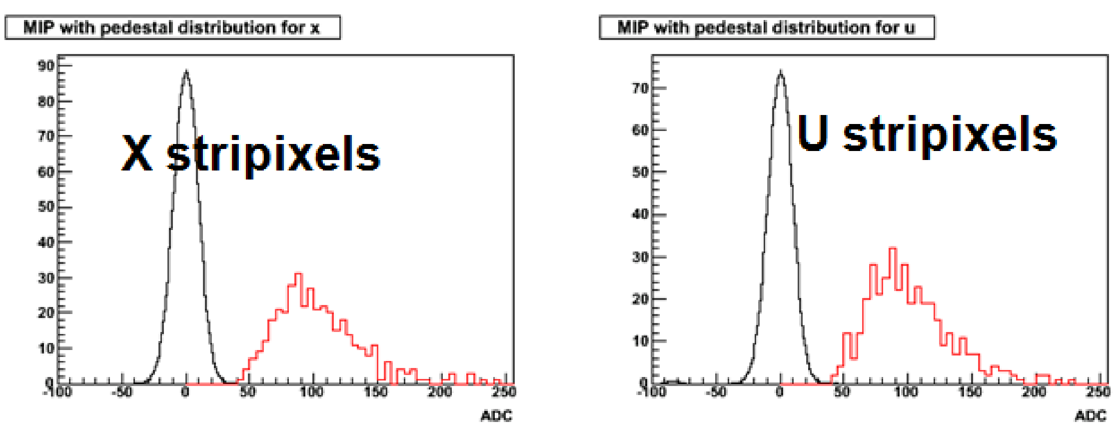

Figure 10 Pedestal distribution and MIP peak of beta-ray measured by a ROC3-prime module (1/4 Oz Cu layer).

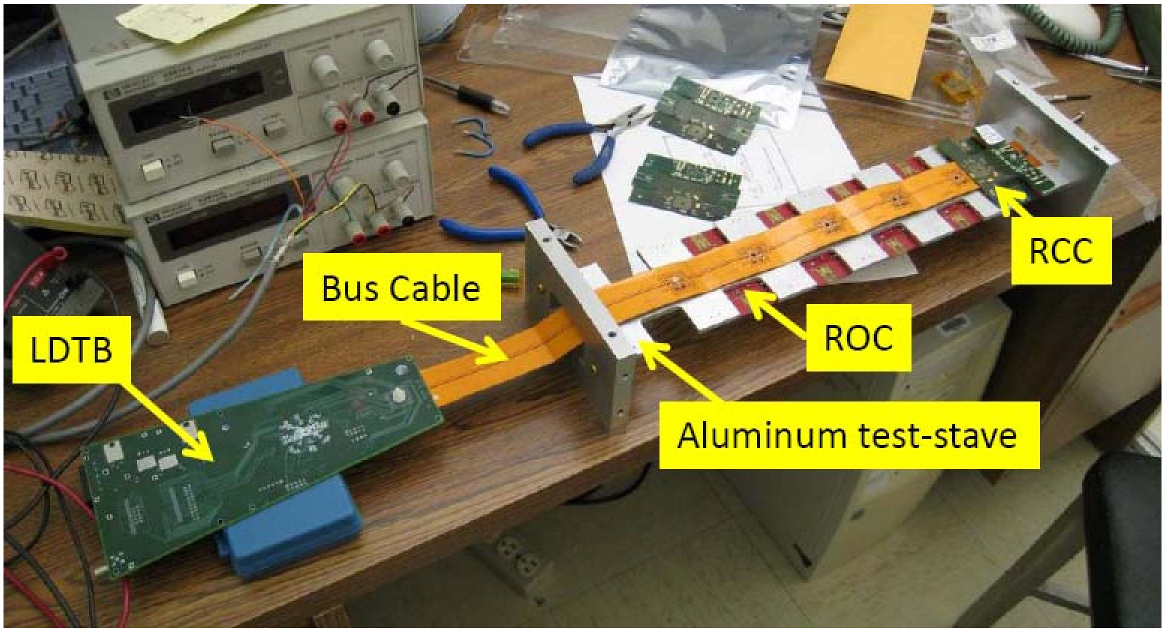

Figure 11 A picture of ppROC read-out test at ORNL. The components of the read-out chain is indicated in the figure. The first ppROC module is placed at the opposite side of the RCC at the far right.

Issues and concerns:

- The strip system is on the critical path of the project. The current schedule shows that the project will be completed at the end of the FY10 with explicit schedule contingency of 15 weeks.

Mechanics:

Successes:

- Pixel stave production is well on-going. Almost all parts (thermal plates and omega-shape) have been produced and about half of them were assembled. The production of 40+ staves will be completed by middle of May.
- Customer Approval Print of the new Be Beam pipe (40mm ID) is signed off by all party involved, and the fabrication of the beam pipe has started. The wall thickness was increased by 0.25 mm to 0.75mm. The impact of the increase was evaluated and found to be negligible. The beam pipe will be completed by October 2009. Then it will be NEG coated at CERN.
- TO#1 tasks at HYTEC has resumed. The priorities on the tasks are set and work is in progress according to the priority. The first priority is the thermal study of the strip stave and the design of the stave (Figure 12).
- Design of VTX support structure (“A-frame”) has started at BNL (Figure 13)

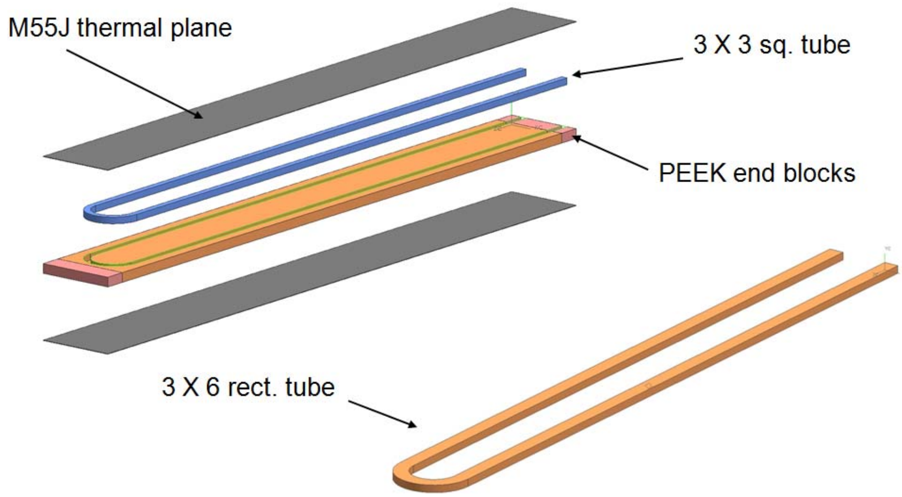

Figure 12 Design of the strip stave. The stave is made of carbon forms sandwiched by carbon fiber thermal plates. A U-shaped cooling channel made of rectangular aluminum tube will be used for cooling.

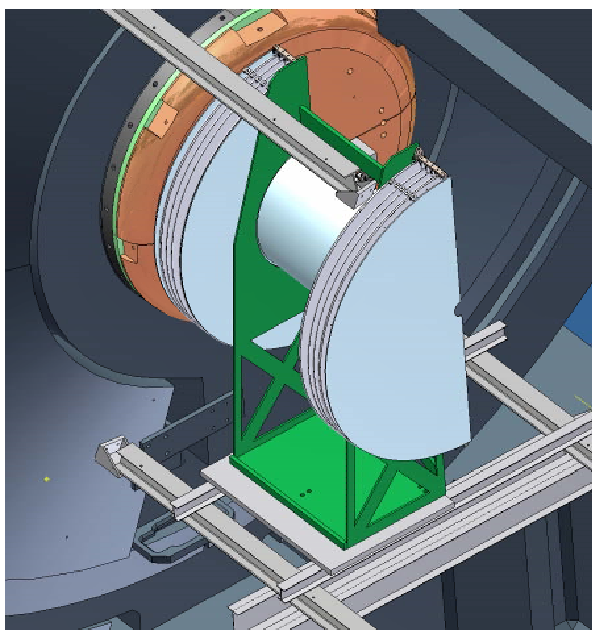

Figure 13 A CAD picture showing the VTX support structure (green).

Software:

Successes:

- b→e / c→e separation simulation.

Full Monte Carlo simulations are done to evaluate VTX's capability to separate b→e and c→e. PYTHIA generated b decay events and c decay events are feed into PISA, the standard PHENIX simulation program. The ratio of b→e / c→e is evaluated as function of DCA cuts and function of pT (Figure 14) with and without DCA cuts. In these simulations, the ratio of b over c is normalized to PYTHIA calculation of b and c cross section. shows that b→e/c→e ratio increases by a large factor with increasing DCA cuts. Thus we can determine b→e and c→e cross sections from the data with and without DCA cuts. Figure 14 shows that b→e decay becomes dominant over c→e for pT>2 GeV/c with a 1mm DCA cuts. For 1<pT<2 GeV/c, the c→e is dominant even with the same DCA cuts. However, we should be able to separate b→e and c→e cross sections in this pT bin from the DCA dependence of electron cross section.

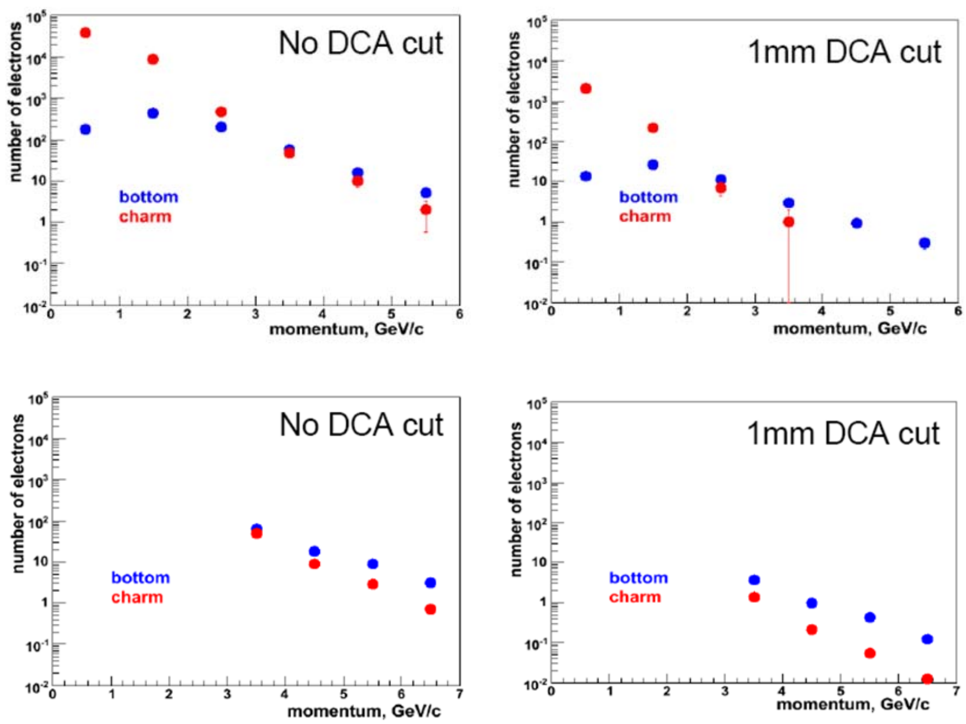

Figure 14 Transverse momentum distribution of b→e (blue) and c→e (red) as function of pT of decay electrons from a full MC simulation of VTX. The cross section of b and c is normalized to that of PYTHIA simulation of p+p at 200 GeV. The left panels are without no DCA cuts in the VTX, while the right panels are with 1mm DCA cuts. The lower two panels are from high statistics simulation of high pT samples.

Issues and concerns:

- Manpower working on the VTX software effort has increased over the last 6 months, but the project would still benefit from additional people. Efforts to improve the situation art ongoing.